Feral Rabbit Populations on Pacific Islands

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IN THEIR MONOGRAPH, Thompson and Worden (1956: 7–22) discuss the world distribution of the European rabbit (*Oryctolagus cuniculus* L.), but make no mention of several colonies established on islands of the tropical and subtropical Pacific. It is worth drawing attention to these both to complete the picture and because of the light they throw on the great adaptability of this species.

LAYSAN ISLAND (25° 46′ N.; 171° 49′ W.): A low, sand and coral island about 2 mi. long by 1 mi. wide, in the northern half of the Hawaiian chain. Groves of sandalwood trees, thickets of bushes, and fan palms formerly grew on the island, which supported a vast albatross rookery and five endemic species of land birds. The guano deposits of Laysan were exploited between 1892 and 1904, and the manager of the works, Mr. M. Schlemmer, introduced various breeds of domestic rabbits, including the large white domestic English rabbit, to the island in about 1903 (Dill and Bryan, 1912; E. H. Bryan, 1942). The island was later set aside as a bird sanctuary. Professor Homer R. Dill led a scientific expedition from Iowa State College to Laysan in 1911. The expedition found that although the rabbits had killed many bushes and nearly exterminated several plant species, they had on the whole done less damage than might have been expected from their numbers. The extermination of the rabbits, however, was recommended as they were likely to eat out the vegetation which would result in the disappearance of the insects on which a number of endemic bird species were dependent (Dill and Bryan, 1912). To accomplish this an expedition of four men was sent to the island for 3 months in 1912–13; unfortunately, they were inadequately equipped to deal with the problem and, although over 5,000 rabbits were shot, there were so many petrel burrows and other cover that without poison it was impossible to eliminate them in so short a time (Bailey, 1956). In 1923 the Tanager Expedition visited Laysan; the island by then had been reduced to a barren waste of sand with a few stunted trees, only 4 of the 26 species of plants recorded from the island were found (Christophersen and Caum, 1931); and there were a few hundred rabbits present. These were shot, the last ones being hunted out individually. The endemic warbler (*Acrocephalus familiaris* Rothschild) had vanished; the last three Laysan honeyeaters (*Himatione sanguinea fraithii* Rothschild) died during a sand storm while the expedition was on the island; and the Laysan rail (*Porzanula palmeri* Frohawk) died out shortly afterwards (Wetmore, 1925). Extermination of the rabbits was completed and no sign of them was seen in 1936, when the island was found to be recovered in vegetation. While circling over Laysan in an aeroplane in 1949, Bailey (1956) found that the vegetation had staged a remarkable recovery and there were concentrations of black-footed albatrosses (*Diomedea nigripes* Forster) and Laysan albatrosses (*D. immutabilis* Rothschild).

LISIANSKI ISLAND (26° N., 174° W.): Another low sand and coral island about 1¼ mi. long by ¾ mi. wide, in the Hawaiian chain, some 115 mi. west of Laysan. Rabbits from Laysan liberated there some time after their introduction on Laysan in 1903 had destroyed the vegetation by 1913, when only a few living but many dead rabbits were seen (Elschner, 1915). When the Tanager Expedition arrived in 1923 the only signs of rabbits were their bleached and weathered bones, and the vegetation was starting to come back. The rabbits, having stripped the vegetation, had apparently died of starvation (Wetmore, 1925).

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J. S. Watson died August 12, 1959, after completing the first draft of this paper. Additional information on rabbits in the Hawaiian Islands has since been obtained and included in the text.—K. Wodzicki.

ISLETS IN MAIN HAWAIIAN GROUP: According to Mr. D. N. Woodside (personal communication), rabbits were introduced to several of the small islets of volcanic origin (10 to 70 acres) lying off the islands of the main Hawaiian group at unrecorded dates before or about 1915. At present only three of the islets are populated by rabbits: Manana ("Rabbit Island") (22° N., 158° W.), off the coast of Oahu; Lehua (22° N., 160° W.), off the coast of Niihau; and Molokini (21° N., 156° W.), situated in the channel between Maui and Kahoolawe. These tuff-cone islets are rather arid, suffering summer drought and occasionally missing sufficient winter rains to alleviate the dryness. The rabbit populations are subject to violent fluctuations, "die-offs" occurring during the droughts, which perhaps enables the vegetation to survive. There are no predators on these islets. The rabbits on Lehua and Molokini appear to be a mixture of domestic breeds, being of every colour; the Manana rabbits closely resemble the American cottontail in colour and ear length and it is conceivable that these rabbits are in fact cottontails (*Sylvilagus* spp.).

PHOENIX ISLAND (4° S., 171° W.): A small coral island about ¾ mi. long in the Phoenix group. There was an American guano company working here in the late 1860's and about this time domestic rabbits were liberated (Bryan, 1942). Lister (1891) found them fairly plentiful in 1889 and they were still fairly numerous in 1924, but apparently were doing no damage to the vegetation (Bryan, 1942). A survey party, which in 1937 caught a number of rabbits there in an unsuccessful attempt to liberate them in the Gilbert Islands, found them in very poor condition, squatting and allowing themselves to be caught after running about a hundred yards. There is no fresh water on the island (Maude and Maude, 1952).

PHILLIP ISLAND: A small island about half a mile long of decomposed basalt rising to 900 ft., lying off Norfolk Island (29° S., 168° E.), originally covered with trees and thick vegetation. Pigs which were introduced at an early date destroyed much of the undergrowth and rooted up the soil, starting erosion. Rabbits were introduced subsequently (Laing, 1915) and the island thronged with them in 1865 and their principal food seemed to be the bark of trees (Brenchley, 1873). By 1912 the island was fast becoming a complete desert; there was practically no soil, only a few isolated trees; hardly a seedling was to be seen and the only grass was in clefts in the rock near the beach (Laing, 1915). Rabbits were still present in 1943 and a single tree was conspicuous in its isolation (Mr. I. L. Baumgart, personal communication).

The present situation on Phillip Island is indicated in a recent letter to Dr. K. Wodzicki from Mr. B. a'B Marsh, Agricultural Officer, Norfolk Island.

Mr. Marsh made a hurried visit to the island on 4 March 1961 and saw rabbit scratchings, droppings, and a few burrows, the last being under the roots of *Lagunaria Patersonii* and another unidentified tree. The visit, being in the middle of the day, was not well timed for seeing rabbits, but, as a very rough guess, Mr. Marsh thought there might be between two and four dozen rabbits on the island. The animals had been eating the leaves of *Lagunaria* which seemed their main food.

Vegetation consists of six Norfolk Island pines (*Araucaria excelsa*), several dozen *Lagunaria* trees, a few unidentified trees with large shiny leaves, a reed known locally as Mo-oo and a few grasses and weeds. The reed grows in a few areas of 1/10 to ½ acre, usually in flat areas where there is enough soil to retain water, but over perhaps 80 per cent of the island there is no vegetation or soil. Rabbits do not eat the reed or the unidentified trees; the latter are the only trees that appear healthy. All trees have their roots exposed to a depth of 1–6 ft.; the pine trees are not actively growing but are setting seeds; the leaves of the *Lagunaria* are confined to the main branches so that the trees look as though recovering from a fire.

The topography of the island is steep with V-shaped erosion gullies at frequent intervals; run-off of water is extremely rapid and complete and carries extraordinary quantities of solid material. The effective rainfall is probably about 5 to 10 in. per annum overall, but the steeper parts retain practically no rain; the island was quite dry only two days after heavy rain. All soil has gone except from a few flat areas and screes, and removal of rabbits will

not now alter the island except in a very minor way.

In March 1953 myxomatosis was introduced, but further introductions were abandoned due to the difficulty of landing. It is now unlikely that any further eradication work will be attempted.

DISCUSSION

These islands provide an interesting contrast. On Phoenix Island, almost on the equator, conditions must be only just within the level of tolerance for the rabbit species, and factors other than food presumably hold the population down to a level where it does not seriously affect the vegetation. Rabbits have been on Phillip Island for nearly a hundred years and must have reached a state of equilibrium with the vegetation, most of which has been destroyed, but some plant species must survive that are both resistant to rabbit grazing and yet sufficiently palatable to support the existing rabbit population. On Lisianski Island no such equilibrium was reached, and it was thought that rabbits would similarly have gone from Laysan Island had they not been exterminated (Wetmore, 1925). Presumably the rate of increase of the rabbits quickly produced a large population, and the vegetation was destroyed to such an extent that it was unable to recover in time to maintain even a greatly reduced number of rabbits. Manana, Lehua, and Molokini islets are all subject to droughts during which the rabbit populations are drastically reduced and presumably the vegetation can recover sufficiently to survive.

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